Impact of Foliar Fungicide on Corn Under Induced Drought Stress

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INTRODUCTION

Agrichemical companies have reported increased yields on corn sprayed with a foliar fungicide under environmental stress. Drought is one of the most yield-reducing environmental stressors on a annual basis. In 2012 alone, an estimated 4 billion bushels in the U.S. were lost due to drought stress. From V8 through V16, the number of potential kernels in each row (row number is determined before V8) is determined within the corn plant based on environmental cues. To maximize kernel set during this period, corn requires over 0.75 cm of water per day. Any instance of drought stress during this critical phase may result in a reduction of corn yield potential.

OBJECTIVES

1) Determine the impacts of late vegetative drought stress on corn growth, development, and yield potential
2) Measure how an early season application of foliar fungicide affects growth, development, and yield potential.

METHODS

- A greenhouse experiment was conducted from Oct. to Dec. 2015 in Howlett Hall Greenhouses at Ohio State University.
- Pioneer corn hybrid P0965AM1 was used for the research
- Full factorial of treatments:
  - Fungicide application
    - Prothioconazole + trifloxystrobin (Strageto YLD) applied at 37 + 110 g a.i./ha (Figure 1)
    - Applied at V4, V6, or V4 + V6, and untreated control
  - Drought treatment
    - 15 day drought starting at V8 leaf stage (Figure 2)
  - Experiment was conducted as a Randomized Complete Block with four replications

Figure 1. Plants at V4 receiving a fungicide application in the spray chamber.

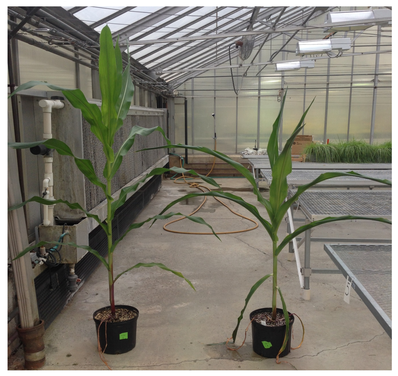

Figure 2. A comparison between a non-drought plant on the left, and a drought plant on the right within a replication.

- Height and leaf stage were measured weekly.
- Heat units were calculated using the average daily temperature minus the base (10°C)
- Total biomass, ear biomass and yield potential were measured at the R1 stage (Figure 3)
- Data were analyzed using SAS 9.4.

Figure 3. Harvested ear at R1 that was measured for yield potential.

RESULTS

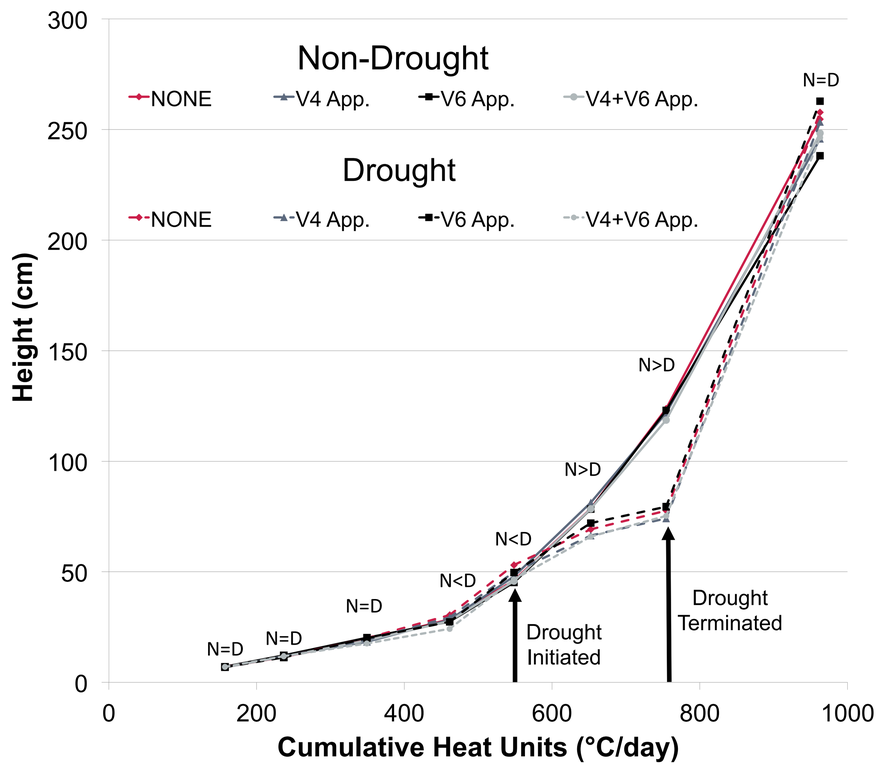

Figure 4. Plant height accumulation from planting to harvest. Significant differences of height for plants within the drought treatments are denoted by sign (α=0.05).

Table 1. Total biomass, ear biomass, average number of kernel rows (ROW), average number of kernels per row (KPR), and total kernels per ear (KPE). No significant fungicide effects were observed. Uppercase letters denote differences between drought treatments. Lowercase letters denote differences of the drought by fungicide interaction. Absence of letters denotes non-significance.

Drought Treatment	Fungicide Application	Total Biomass (grams)	Ear Biomass (grams)	ROW	KPR	KPE
No	NONE	114.01A	0.40c	13.5B	39.92	539b
	V4	106.01A	0.92b	14.0B	44.67	625ab
	V6	115.17A	1.70a	15.0B	46.17	693a
	V4 + V6	103.58A	0.38c	13.0B	42.33	550b
Yes	NONE	99.21B	0.54bc	15.0A	43.92	661a
	V4	94.51B	0.58bc	15.0A	46.17	691a
	V6	100.10B	0.54bc	14.5A	43.00	625ab
	V4 + V6	92.60B	0.73bc	15.5A	44.67	693a
Factor		*P*-Value				
Drought		<0.001	0.059	0.009	0.386	0.026
Fungicide Application		0.087	0.007	0.772	0.327	0.363
Drought * Fungicide Interaction		0.941	0.002	0.082	0.309	0.053

DISCUSSION

- The plants assigned to the drought treatments were taller than the plants assigned to non-drought treatments before drought initiation (Figure 4). During the drought, the plants in the non-drought treatments continued their normal growth pattern, while the growth of plants under drought treatments tapered off.
- After drought termination, the plants exposed to drought rapidly increased in height but had significantly less total biomass at R1 stage than plants in the non-drought treatments (Table 1).
- A single fungicide application, either at V4 or V6, significantly increased ear biomass of plants in the non-drought treatments (Table 1).
- The drought treated plants exhibited higher yield potential due to a greater number of kernel rows on their ears (Table 1), which may be due to the height advantage of the plants assigned to the drought treatments before V8 drought initiation.

CONCLUSIONS

- The drought treatment effectively reduced plant height during the drought period, but the plants were able to accelerate height accumulation and achieve as similar height as the non-drought plants at R1 harvest.
- Drought stress reduced total plant biomass and delayed height accumulation, but did not affect kernels per row.
- Fungicide applications increased ear biomass under non-drought conditions, but did not influence ear biomass under drought.
- Yield potential was influenced more by early season growth (number of kernel rows) than stage of fungicide application.

FUTURE RESEARCH

In order to validate our results, the research will be conducted again next fall. Based on the results from the first year, potential changes to the experiments methodology will also be considered:

1. Having 6 replications instead of 4;
2. Transporting all plants from the greenhouse to the spray chamber during fungicide applications;
3. Increasing the duration and severity of the induced drought stress; and
4. Delaying harvest to a later reproductive stage to measure grain yield rather than yield potential.

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ACKNOWLEDGEMENTS
The authors would like to acknowledge DuPont Pioneer and Bayer CropScience for their donation of materials, and the Undergraduate Research Office at Ohio State for their financial support through the Research Scholar Award Program.